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Dismantling Utopia of False Information in The Digital Era through The Lens of Bibliometric Analysis

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Abstract: With the rapid development of technology and wide exchange of information, false information or fake news can easily be spread. The challenge not only comes from content that is easily created and manipulated using AI technology such as the Deep fake algorithm, but the presence of social media can spread misinformation throughout the world in a matter of seconds. There are various motivations for creating fake news, such as economic gain and politics. This paper aims to analyze current research on false information using bibliometric methods. Trends in research, as well as links between studies, are evaluated in depth. Emerging research themes is also elaborated. Based on the analysis, the trend on the theme of fake information is currently increasing. Various research are published to understand the phenomenon and to find the potential solutions. Generally two research streams are emerged in this topic. The first stream is focused on the human factors such as educating society to be more critical in responding to the information, and studying human behavior towards the fake news. The second stream is focused on how technology able to help to tackle fake news. Several technologies are often mentioned, such as blockchain to store and trace the spread of fake news, artificial intelligence to categotize true and false information automatically, and social network analysis to analyze chain and distribution of fake news. Based on the literature study, a framework of solution built that combined both human and technological measure to combate the fake news.

Keywords: Fake news, Digital Era, AI, Human, Review.

1. INTRODUCTION

Information has become abundantly available since the era of the Internet. The volume of transmitted data is increasing significantly. Additionally, social media also contributed heavily. Social media allow people to create and share vast amounts of information freely. Information can be shared millions of times with social media users across the world. However, this huge volume and distribution of information can be potential opportunities to spread fake news and false information [1]. One of the prominent examples is the spread of disinformation related Covid-19 pandemic [2], [3], [4]. COVID-19 has upbringing grounds for fake news resulting in prevalent panic, which leads governments worldwide to put effort into publicising trustworthy information to its people. World Economic Forum referred to this global fake news related to the COVID-19 infodemic [3]. The fake news is mostly made from sources that depend upon clickbait both for financially and/ or politically motivated sources, fake profiles on social media, and heightened by being heavily shared/forwarded on mobile messaging applications [5], [6]. This fake news is shared in various forms, such as text, image, voice, and videos, which consequently has a significant impact (negative or positive) on people using the internet, especially social media users. In distributing this fake news, millions of bots work over fake profiles that drive the circulated content viral which then is perceived as accurate information by people and being shared to their circle

On the other side, the advancement of big data and artificial intelligence technology may also lead to worsening the situation. For example, by using deep learning, technology able to imitate someone else in the form of audiovisual, which can mislead the public opinion. Additionally, the advancement of data analytics, combined with sophisticated people profiling based on social networking activity, open doors for the direct Fake News to a very precise target of the population to influence people in various segments, such as politics and public security [7], [8]. To combat this problem, many researchers have made recommendations and solutions, both using technology and non-technological measures.

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AI, social network analysis, and blockchain are technologies that are believed to be able to eradicate fake news, combined with expert judgment and crowd evaluation as non-technological measures. Considering this phenomenon, this paper aims to analyze available research regarding fake news using bibliometric analysis. Bibliometrics can effectively show the trend and link in the wide spectrum of research which can bring valuable insight that can be leveraged by researchers, policymakers, and other stakeholders to take recommended action on specific problems [9].

2. METHODS

This research is performed using bibliometric analysis to assess available papers related to the fake news phenomenon. Bibliometrics is a statistical method that performs quantitative analysis of research papers on specific issues using mathematical techniques [10]. It could also assess the main areas of research and provide direction for future studies [11]. Some tools are available to perform this process, such as Vos Viewer [11]. Vosviewer creates visualization by mapping authors, journals, and keywords from the dataset [12], [13].

This research uses secondary data collection from the Scopus database to retrieve the relevant papers that discussed the topic. Some keywords are used to find relevant articles, which are "combat* (OR) tackle* (OR) prevent* (AND) "fake news", (OR) HOAX (OR) disinformation (OR) misinformation. Some filter is used to limit the relevancy of the retrieved articles. The search is performed on research articles that were published between 2015 to 2024, written in English, and only retrieved journal articles and conference proceedings. In total, there are 1632 relevant articles are found. The retrieved bibliometric data from relevant articles is then processed and analyzed into bibliometric analysis tools, Vosviewer. Various data can be used for data mining in Vosviewer such as citations, bibliographic coupling, co-citation, or co-authorship relationships.

3. RESULTS

A. Research Trend and Statistics

Research trends first are performed to analyze the popularity of the topics in the research field year by year. Based on data that are collected from the Scopus database, the number of publications on this topic between 2015-2018 is always below 100 (figure 1 - left). However, it started to rise to 126 in 2019, and, the climb significantly from 2020 to more than 400 publications in 2023, to be precise, when infodemic or fake news regarding Covid-19 spread massively creating panic attacks for people worldwide (World Economic Forum, 2020). Since then, many researchers are keen to know and deep dive into the issue and try to find a solution to tackle it.

The leading publication on this topic is the CEUR workshop proceeding which can be seen in Figure 1 (right) in red line. Besides the CEUR workshop proceeding, the ACM International Conference proceeding series also has contributed to a significant number of publications on this theme. The other main contributors to this topic are the Journal of Health Communication, Social Media and Society, and Proceedings of the ACM on Human-Computer Interaction.

On the other hand, based on geographical position, the United States is the leading country majoring in this topic of publication, which contributes to more than 550 publications (figure 2 - left), followed by India in the second place (169 publications), and China in the third place (114 publication). Other countries which also have significant publications on this topic include the United Kingdom, Australia, Spain, Canada, Germany, Italy, and Indonesia. Figure 2 (right) shows, in the terms of the subject of publications, this topic mainly lay in the subject of Computer Science (29%) and Social Science (27%), which indicates that most research focuses on how fake news is created and distributed, and also developing solution to against it using both computing technology and social measure. Other subjects also contribute below 10%, such as Engineering (8.7%), Decision Science (6.7%), and others.

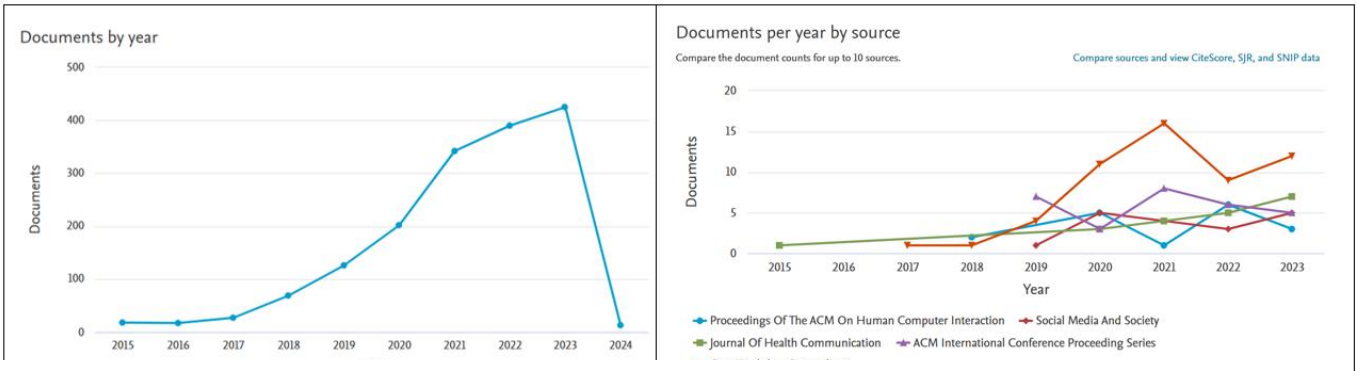

Figure 1. Number of publications annually (left), Documents per year by source (right)

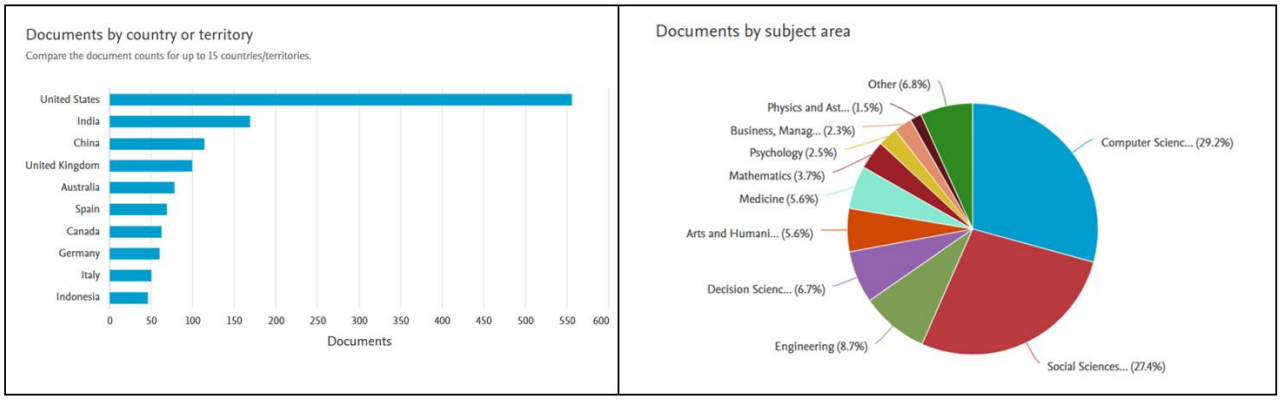

Figure 2. Documents by country (left), Documents by subject area (right)

B. Most Cited Articles

Besides research trends and statistical overview, the most cited articles are also analyzed to check the most influential publications on this topic [11]. The citation number has been frequently used to see academic influence [14]. H-index and G-index are some widely used indexes in gauging the influence of research in terms of contribution to the literature. Based on the data retrieved from the database, table 1 shows the 10 most cited articles on the topic being observed.

Table 1. Top 10 Most Cited Articles

Author	Year	Cited by	Topic	Detail	Event
Wang, W.Y.	2017	602	AI	Create Dataset with label	General (Politic)
Romer, D., Jamieson, K.H.	2020	593	Human Behaviour	Factors to prevent acceptance of fake news (covid)	Covid19
Bakir, V., McStay, A.	2018	462	Journalism	Factors caused believe in fake news	US Election
Chou, W.-Y.S., Budenz, A.	2020	436	Human Behaviour	Considering emotional factors to combat fake news (covid)	Covid19
Vraga, E.K., Bode, L.	2017	266	Human Behaviour	Analyse influence of news source	Health
Nasir, J.A., Khan, O.S., Varlamis, I.	2021	263	AI	Deep learning method to detect fake news	General
Jang, S.M., Kim, J.K.	2018	237	Human Behaviour	Third person perception give more influence than in group.	US Election
Pennycook, G., Bear, A., Collins, E.T., Rand, D.G.	2020	218	Human Behaviour	Analysing impact of tagged warning in fact news headline	General
Naeem, S.B., Bhatti, R.	2020	192	Journalism	General framework to combat fake news: myth busters, fact-checkers and credible sources	Covid-19
Naseem, U., Razzak, I., Khushi, M., Eklund, P.W., Kim, J.	2021	189	AI	Labeling as positive/ negative. Negative sentiment play important role in shaping public sentiment	Covid19

Among the top 10 most cited articles, most of the research is focused on covid-19 issue, such as done by Romer and Jamieson [15], [16], [17], [18]. This indicates that many research talked about fake news during the COVID-19 pandemic considering how massive the information flow is and how serious the effect is. The other theme that has high citations is the United States Election which is being researched by Bakir and McStay [19], and Jang and Kim [20]. On the other hand, some popular subjects are also being widely cited, such as human behavior which is researched by Romer and Jamieson [15], Chou and Budenz [16], Vraga and Bode [21], Jang and Kim [20], and Pennycook *et al.*, [22]. In this subject, most of the research aims to explain how people receive false information, by finding and explaining important factors that can influence people's behavior. Besides human behavior, AI (Artificial Intelligent) is also the subject of research that is being cited by many researchers that discuss fake news, such as research from Wang [23], Nasir *et al.*, [24], and Naseem *et al.*, [18]. Many paper that focus on AI discuss how AI

can detect false information, for example by testing different types of algorithms.

C. Bibliometric by Authors' Keyword

After analyzing most cited articles, text analysis is done to discover evolving themes from the previous research. Figure 3 shows a co-occurrence network based on the author's keyword. Full counting is used as a counting method so that each word is measured by the number of occurrences in each document. The minimum number of occurrences is set to 10 to find the words that appear more frequently.

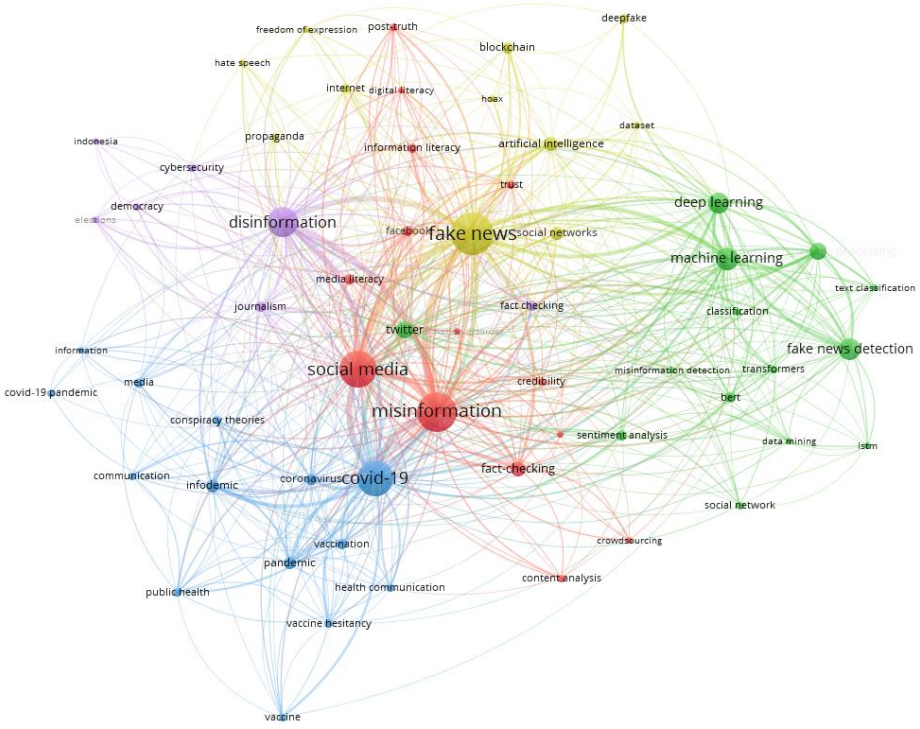

Figure 3. Bibliometric by author's keyword

In total 60 keywords appeared. As a result, 5 clusters with different colors appeared as a network with different colors. Keyword that are more protruding in terms of size implies a high frequency of occurrence [25], and thus can be thought to be more important rather the other keywords [12]. Besides that, the nearness of keywords denotes a higher incidence of co-occurrence [25]. The network does not spread widely which indicates that each cluster has a close connection with the other cluster. It also signifies that the topic between clusters is closely interconnected. Five clusters are highlighted in red (first cluster), green (second cluster), blue (third cluster), yellow (fourth cluster), and purple (fifth cluster).

Some prominent keywords in the first cluster are social media, misinformation, fact-checking, information literacy, and Facebook. This implies that this network focuses on researching the distribution of fake news such as social media. Social media is considered to be a medium to crowdsource information, which allows everyone to not just be the consumer of information but also the creator, and distributor, which leads to a vast amount of information sharing. Therefore, it is also a significant channel for distributing false information [26], [27], [28]. Facebook appears as a prominent keywords in the cluster which signify it is largely being observed in the research related to the fake news. Another prominent keyword is misinformation, which is defined as false information that is perceived as true information since it presents credible information alongside personal opinion [29], [30]. Misinformation is one of the challenges to combat since most people do not realize that the information is false and keep sharing it with their contacts and followers.

In the second (green) cluster, 'machine learning', 'deep learning', 'natural language processing', and 'fake news detection' are the most obvious keywords that are shown. The research in this cluster aims to detect and combat fake news using artificial intelligence technology, especially machine learning [31] and deep learning methods [32], [33]. Machine learning uses feature extraction such as linguistic features and propagation patterns, that is being done manually [34]. One of the drawbacks is that this method is commonly time-consuming and may result in biased features. Deep learning on the other side, copes with the limitations of

machine learning since it can study unseen representations using neural networks, therefore the manual extraction of the features is not needed [34].

'Covid-19' is the most prominent keyword in the third (blue) cluster, since this cluster focused on tackling fake news related to the Covid-19 pandemic, also referred to as 'infodemic'. Many of misleading information is related to the 'vaccine', creating 'vaccine hesitancy' in the public. Therefore, researchers tried to tackle this by effectively communicating valid information to the public using various 'media' to combat all false information related to COVID-19 and misleading information about the vaccine.

misinformation, parody, and satire. True information with malicious intentions includes misleading content and irrelevant content. News that cannot confirm its validity can be categorized as conspiracy theory and clickbait when it does not have malicious intention, and rumor when it has malicious intention. Overall, some definitions can vary between researchers therefore it is important to pay attention to the explanation in each research. Some technology is also mentioned in this cluster since various types of fake news need different approaches to understand and combat [38]. 'artificial intelligence', and 'Deepfake' are keywords that signify how current technologies can help to develop fake news.

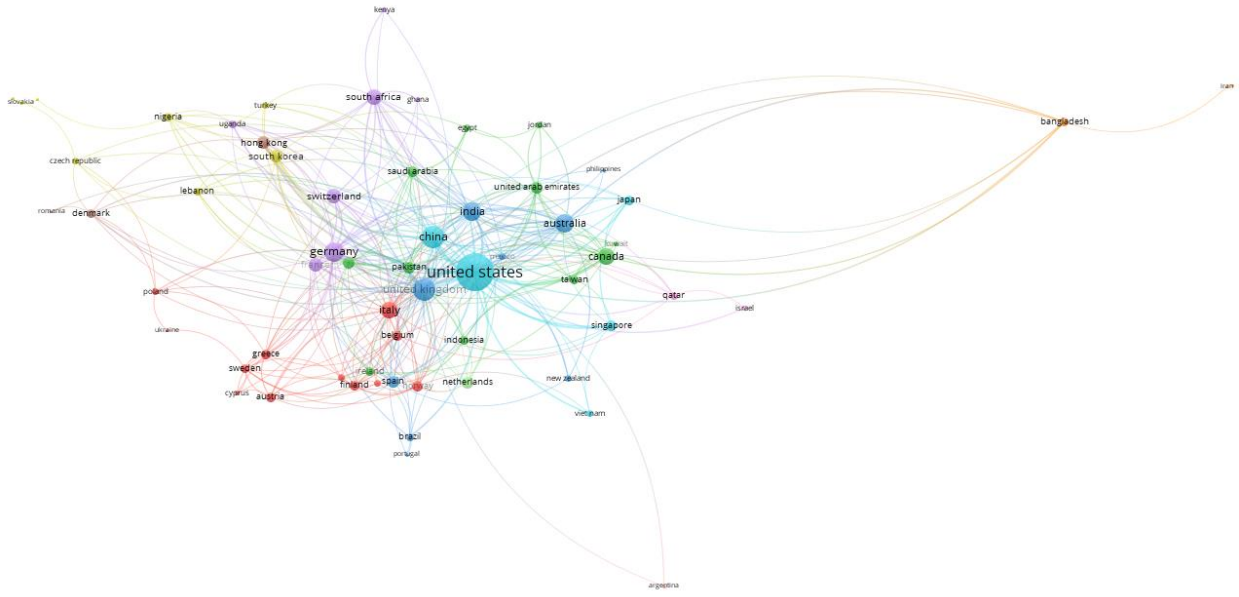

Figure 4. Co-Authorship By Country

The fourth (yellow) cluster talks about the type of fake news, and how the fake news is created and distributed. Some prominent keywords such as 'fake news', 'hate speech', 'hoax', and 'propaganda', tell the reader about the type and explanation of fake news. The word 'fake news' commonly is used as an umbrella term to describe wrong information that spreads in society [35], [30]. The researchers then create a taxonomy of fake news based on its characteristics. As an example, Wardle and Derakhshan [36] distinguish between three types of misrepresentation of information: misinformation, disinformation, and mal-information. Nasery *et al.*, [37] define fake news based on the truthfulness of information (true vs false), and intention (malicious vs non malicious intention). False information with malicious intentions includes disinformation, hoaxes, serious fabrication, and propaganda. False information with no malicious intention includes

For the distribution, 'internet' and 'social network' are discussed. Lastly, this cluster also talks about how technology can help to combat fake news, such as by using 'blockchain', 'artificial intelligent', and 'social networks'.

Lastly, the fifth (purple) cluster is the smallest cluster among the others. Some distinct keywords are 'disinformation', 'journalism', 'fact-checking', and 'democracy'. Disinformation is a type of fake news that is created with malicious intentions [37], [39]. This cluster discusses from the perspective of journalism and explains how disinformation violates law and ethics for financial and political aims. Therefore, researchers are keen to find solutions for this problem such as by creating fact-checking sites and applications [40], [41]. The effectiveness of the fact-checking platform is also analysed in this cluster [42], [43].

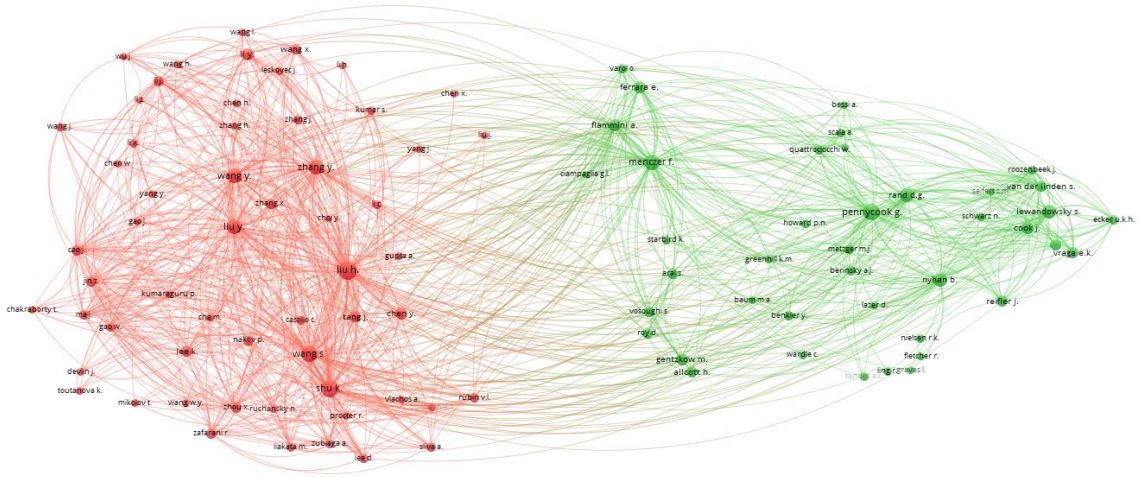

Figure 5. Co-citation by Cited Authors

Besides bibliometric by author's keyword, bibliography co-authorship by country is analyzed to check countries that have significant publications on the topic, and the network of country's authorship. Based on Figure 4, the United States is leading in this research topic (cluster in blue color). It has strong relationships with other countries which also have huge numbers of publications such as China. Another distinct cluster is the cluster in blue color which is led by the United Kingdom and has a strong connection with India, Australia, and also with the United States from different clusters. The other cluster which has a prominent network is highlighted in green which is led by Canada, and purple which is led by Germany. Canada has tight relationships with some Asian countries such as Taiwan and United Arab Emirates, while Germany has tight relationships with France and Switzerland.

Co-citation by cited authors refers to the authors that are frequently cited together in a document/ paper. Figure 5 shows two big clusters of authors being cited together, which are highlighted in red and green colors. Most of the authors in red colors focused on technology that can detect and combat fake news, such as artificial intelligence, machine learning, and deep learning [44], [45], [46]. Meanwhile, in the green cluster, human behavior is the main topic of the research. Some prominent authors are Pennycook *et al.*, [22], Pasquetto *et al.*, [47], Lewandowsky *et al.*, [48], Vraga *et al.*, [49] which explore and discuss the factors related to human behavior which can lead people to accept or reject false information.

4. DISCUSSIONS

The vast amount of fake news that spreads in various forms via multiple sources creates an unprecedented challenge to tackle. Based on the analysis from the previous research, the authors developed a framework that utilizes both technology and human factors that aim to combat the false information depicted in Figure 6. The goal is to create reliable ratings for each news and news

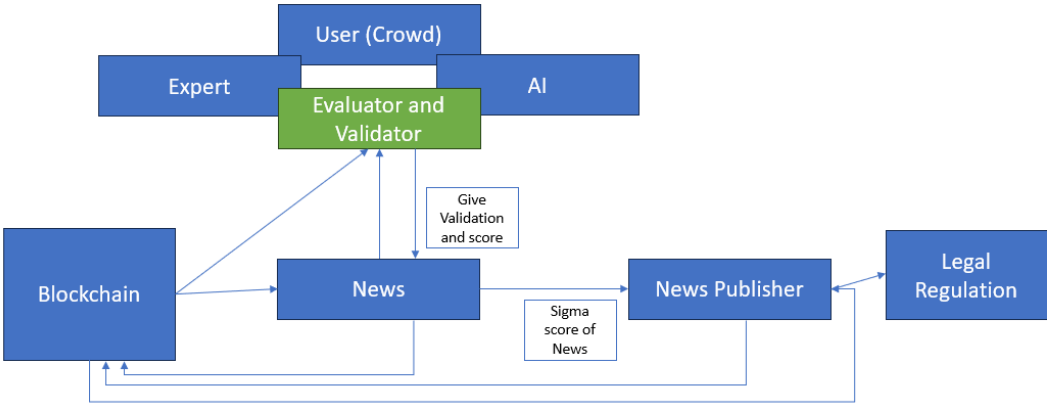

Figure 6. Framework of The Solution

publisher so that readers can be more firm in believing every news. Each news that is published is stored in the blockchain database which also aims to trace the first source of the news [50], [51]. Thus, each news will be categorized if it is first source, a secondary source, and the chain of distribution. This is because the news spread on the internet is very easy to destroy and manipulated [50], [52], [53], [54]. The blockchain system also categorizes the news based on the type of news, such as journalism, opinion, research output, and so on. Then, each piece of news will be evaluated by using a combination of human knowledge and AI. Human knowledge is a combination rating that is based on expert judgment, and users (crowd) as suggested by Pennycook and Rand [55], Micallef *et al.* [56], Vlachos and Riedel [57], Chung and Kim [58]. This is because some types of fake news cannot be verified by AI technology alone such as suggested by Butincu and Alexandrescu [59]. The evaluation that is being produced by humans and technology is then combined into one rating for the news. The rating of the news also will be attached to the source that distributes the news, both for the first news distributor and all parties that help to spread the news in a real-time [60]. The targeted parties to be assessed and evaluated are analyzed with SNA to find the most influential people who spread the news. So that users could check the person's rating and historical evidence of the person spreading the news. Legal and government authorities are also expected to take measures in response to all parties who deliberately spread false information with malicious intentions [61], [62], [63]. This solution requires collective action from various parties to build and run, yet it could be a comprehensive solution that leads more informed society in the era of information truthfulness becoming more vague.

CONCLUSION

Based on the bibliometric analysis, the research related to false information or fake news is currently growing. The significant rise in the number of publications started from the covid-19 pandemic when a massive amount of false information was shared among people worldwide creating a utopia that leads to difficulty in reducing COVID-19 cases. Generally, research on this topic has two streams. The first stream focused on human behavior and analyzed and explored various factors that can affect someone in consuming information, as well as factors that can prevent someone from believing false information. The second stream focused on analyzing technologies that are able to facilitate the creation and distribution of fake news, and also using technologies to detect and combat fake news. A number of solutions emerged from previous research, such as improving information literacy among people and developing fact-checking sites. Emerging technologies are also named to be solutions for the issue, such as artificial intelligence to detect fake news, and social network analysis to find the main actor and distribution channel of fake news. On the other hand, this research field needs a comprehensive solution to be implemented that requires collective action from many parties, such as governments, legal authorities, social media platforms, subject matter experts, journalists, technology vendors, and citizens.

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